

A Framework of Sustainable Development in Continuing Engineering Education Programmes in Malaysia

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Abstract

Continuing education (CE) is increasing its importance as part of university education. Engineering Education is one of the disciplines under the scope of CE programmes offered by CE centers in Higher Education Institution (HEI) in Malaysia. The main objective of Continuing Engineering Education (CEE) is to help practicing engineers, technologists or technicians stay current with technological advances relevant to their current or future jobs and indirectly they are also involved in the country development. However, continuing engineering education faces some classic and some new challenges. One of the critical challenges common to all engineering disciplines is the need for sustainable development of the programme. Although there are programmes that have successfully implemented skills into their curriculum, there are many factors that serve to hinder the philosophy of sustainability which may be contributed due to the non existence of guideline in CE centers. Hence the purpose of this research is to (i) determine the current status of sustainable development orientation in CEE centers and (ii) develop the framework of sustainable CEE programmes. This quantitative-designed research is carried out using modified Delphi method which involves participation from 33 experts in relevant fields that purposively chose regarding their positions. This methodology required two cycles of instrument distribution to get a consensus from the experts by using questionnaire form and supported by interview. The findings showed that the framework consists of eight components such as quality assurance (mean=4.3212), instructional method (mean=4.2987), learning outcome (mean=4.2970), curriculum design (mean=4.2606), staff (mean=4.2242), facilities and support (mean=4.2000), assessment (mean=4.1465), and program needs (mean=4.1152). All components comprise 43 characteristics of sustainable development. Overall, the framework can be used as guideline to design and implement CEE programme to better equip the students to introduce and teach others with respect to sustainable development value and practices.

Introduction

There are still many unsolved issues around us especially in industries that is related to economic vitality, justice, social cohesion, environmental protection, inefficient use of energy, lack of water conservation, increased pollution, abuses of human rights, war, poverty, overuse of personal transportation, consumerism, and the sustainable management of natural resources, so as to meet the needs of the present generation without compromising the ability of future generations to meet their needs. It needs paradigm

shift in addressing this issues for sustainable development. Many of this inequities experienced around us need to be eradicated whilst survival of the human species warrants serious consideration and action, with a particular need to deal with climate change. Development needs to be recognised as more than a narrow measure of material prosperity and economic growth. It needs to incorporate health, education, democracy and freedom and as a society we need to be aware of and engage in numerous forms of action that will make a difference. Therefore, sustainable development is critical and should be considered to be an essential direction for our world to move forward and for our quality of life.

Universities have a major role to play by introducing not only sustainable development teaching into the curriculum across the spectrum of courses offered but also the program itself is sustainable. However, the focus of this paper is on continuing engineering education, more than on the natural and physical sciences or on social science, because most unsolved issues around us are most from the industrial activities and that it affects our quality of life. These activities implement scientific advances and is generally rooted in engineering.

Conceptualisation of Sustainable Development

Over the last 30 years, the concepts of "sustainability" and "sustainable development" have been introduced in order to address the causes and effects of humanity's increasing impact on the world. Sustainable development is a concept proposed by the Brundtland Commission, which leads to a re-evaluation of the future, and the establishment of a new development pattern: "...sustainable development attempts to satisfy current needs without compromising the ability of future generations to fulfil their own needs". This concept links the importance to satisfy human aspirations to continuity for the benefit of future generations. The use of resources, the course of investments, the direction of ecological development and transformation, the strengthening of institutions, and all action aimed at development should be in harmony, leading to an improvement in the abilities of people, which are needed to satisfy the needs and aspirations of the human race. Thus, sustainability can also be defined as "design of human and industrial systems to ensure that humankind's use of natural resources and cycles does not lead to diminished quality of life due either to losses in further economic opportunities or to adverse impacts on social conditions, human health and the environment". This concept is in line with the definition of "sustainable development" by the World Commission on Environment and Development (WCED) which defines as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The objective of sustainable development is to resolve environmental problems as well as social and economic problems (Seliger, Kernbaum and Zettl, 2006). Although objectives of sustainable development can be clearly stated, the road towards sustainability is much less clear. It has been argued that competitiveness, environment, and employment are the operationally important dimensions of sustainability (Ashford, 2004)

Paradigm Shift for Engineering Education

As the global population grows and standards of living improve, there will be increasing stress on the world's limited resources. Thus among the professionals critically involved, which includes engineers of the future, will be asked to use the earth's resources more efficiently and produce less waste, while at the same time satisfying an ever-increasing demand for goods and services. To prepare for such challenges, engineers will need to understand the impact of their decisions on built and natural systems, and must be adept at working closely with planners, decision makers, and the general public. Sustainable Engineering emphasizes these and related issues and aims for equity between different parts of the world and between generations. However many still do not fully aware that there are still many industry that is unsustainable by design. To achieve the goal of Sustainable Engineering, scientists and engineers must use their best imagination, judgement and take initiative to apply science, technologies and practical experience to shape competitive processes and products (Huntzinger, 2005). After all, it is assumed that the core elements of the engineers' role in modern society are project management, problem solving and solution development. Sustainable engineering challenges are the design of products and processes with improved usefulness and less environmental harm. Technology enables processes to transform natural resources into products to meet human needs. In order to achieve the ambitious goals of sustainability, a paradigm change in applying engineering has to be performed and thus the paradigm of engineering education too has to be changed.

Since engineers are frequently known as 'problem solvers' and if economies are becoming unsustainable because of engineering, we should perhaps come up with a new continuing education strategy, in achieving sustainable transformation where the scientific, social and legal change are taken into play. Hence, CEE will be one of the most significant components for human resource development, through the inculcation of innovative sustainable training, with a potential for adding value to products and services towards improving the quality of life.

Continuing Engineering Education (CEE) For Sustainable Development

In relation to that, Sustainable CEE therefore may be defined as those activities related to the professional development and enhancement of the engineers, technologist and technicians that meets the needs of the present without compromising the ability of future generations to meet their own needs. This could lead the goal of sustainable development so as to create ecologically and socially appropriate solutions of the engineering world or industries within the capacity of nature without compromising future generations.

Recently The Ministry of Higher Education in Malaysia (MoHE) call all higher institutions in Malaysia to have a centre or unit that could promote and implement CE activities or programmes with the prime objective of inculcating a Lifelong Learning culture. Nonetheless, UTHM have been implementing CE

programmes through its CE centre (CEC UTHM) but it focuses more on offering engineering and technical courses.

It is at the very core of the mission of continuing engineering education to be well attuned to industrial needs and perspectives. Although objectives of sustainable engineering can be clearly stated, the road towards sustainability is much less clear. In the context of continuing engineering education, professional education and development for engineers, technologists and technicians occupies a distinctive niche. It involves the activities of "The maintenance and enhancement of the knowledge, expertise and competence of engineering professionals throughout their careers according to a plan formulated with regard to the needs of the engineers (professional), the employer, the profession and society" (Madden & Mitchell 1993, p 12).

Research found that there was a lack of knowledge and awareness concerning sustainable development (VSNU, 2000) among students and also engineers. Not only that, they were not well equipped with the knowledge and skills to participate in sustainable processes in the workplace (eg. in the design and manufacturing). They were also not trained to be able to manage the change and uncertainty and make judgments about the best course of action based on the available evidence. This requires our students or future engineers to be equipped with creative problem-solving skills and to be able evaluate the implications of their solutions beyond their immediate technical context. Therefore, re orienteering the programs of CE for sustainable development is a key issue. There is an assumption that engineering as a discipline will take a leading role in this in order that the engineers become well prepared for the transition towards a sustainable industry. Thus there is a need for effective teaching methods, reform existing programs, and practices so that they foster the concepts, skills, motivation, and commitment needed for sustainable development. Successful integration of sustainability principles and methods into engineering curricula requires a systemic change in our approach to education and societal values (Ashford, 2004). Students not only need the knowledge base to make sound engineering decisions, they need the intellectual development (e.g. higher-level cognitive and critical thinking skills) to supply effective solutions to complex technical problems (Huntzinger, Hutchins, Gierke and Sutherland, 2005)

Sustainable CEE programmes should be designed so as to educate and train professionals who can integrate the disciplines of green engineering and social sciences, producing professionals who can serve as catalysts for future environmental, industrial and societal sustainability. The integration of sustainability concepts into engineering curricula needs to occur with the concomitant facilitation of intellectual growth and development and creative thinking. In order to promote those development instructors should employ pedagogy that encourages a deep approach to learning facilitated by a variety of learning tasks, clear communication of expectations, constructive feedback, mutual respect, and a student-centered learning environment (Monzon, 2005).

CEE not only brings about competency enhancement (and thus increased productivity), but is also a means of converting 'job seekers' to 'job givers'. It is, therefore, imperative to emphasise on quality CEE for overall improvement of the economy by enhancing the global competitiveness of technical manpower and by ensuring excellent technical education to all sections of society. Therefore CEE must be adaptive and multidisciplinary as it is education for other wide-ranging and fast-moving engineering fields. Engineering educators have to address these challenges. Thus this paper addresses one of the challenges of CEE, if this vision is to be realized, ie by having a framework for a sustainable CEE. This framework is critical and timely as scholars and professionals committed to fostering sustainable development, have urged a re-examination of the programmes and organization in CE-focused institutions of higher learning (Anis 2008).

Nevertheless there has debates in Malaysia on how future engineers could participate in sustainable design and manufacturing and it is often surrounded by uncertainty and ambiguity. It is anticipated that they will be required to evaluate and apply information from multiple disciplines, such as economics, public policy, the environmental and social sciences. However, critical thinking skills and the ability to collect, evaluate, and utilize information are often not advanced in current engineering graduates. They also have little or no experience of dealing with uncertainty and ambiguity in problem solving. Too often, engineering curricula place more emphasis on the memorization of facts and well-established procedures than on learning the skills necessary to deal with large, complex problems. As a result, there is an issue of unsatisfied employers with ill-equipped and incompetent graduates (Wahid 2006).

Thus the Conference of Continuing Technical Education and Training (CCTET 2007) at UTHM has highlighted the global need for a reorientation of continuing technical education for sustainable development and emphasized the importance of effective training and teaching methods (Noraini, 2007). In addition, it has also identified the need to reform existing continuing education policies, programs, and practices so that they foster the concepts, skills, motivation, and commitment needed for sustainable development. This new vision of continuing education includes "linking social, economic, political, and environmental concerns" that will enhance critical analysis while nurturing creativity and innovation. Successful integration of sustainability principles and methods into continuing engineering curricula requires a systemic change in our approach to education and societal values. Students not only need the knowledge base to make sound engineering decisions, they need the intellectual development (e.g. higher-level cognitive and critical thinking skills) to supply effective solutions to complex technical problems.

Among the elements of skills relevant to be integrated in the CEE programs for engineers are:

- recognize the problems of our global society;
- assess the contribution that technology might offer in solving these problems;
- assess the limitations of technological solutions;
- acquire a basic knowledge of social science; and
- study interdisciplinary projects in cooperation with students of social sciences or humanities.

Industrial Skill Enhancement Programme (INSEP) at UTHM: An Example of a Sustainable Continuing Technical/Engineering Education

One of the most successful student-centered learning tools is problem-based learning (PBL).

PBL is the "learning that results from the process of working toward the understanding or resolution of a problem" (Saren Lund, 2006). Engineering professionals are routinely confronted with complex problems that require analytical, innovative, critical thinking and reasoning skills. In addition, engineering professionals are constantly faced with new types of problems, as well as new information about existing problems. As in medical, more than half of what the engineering students learn in university will be outdated by the time they are in practice.. This means that students must not stop educating themselves after getting their degrees and that they must become effective and efficient life-long learners. In the case of UTHM, INSEP program implement the approach of Project Oriented Problem Base Learning (POPBL) and adapting the dual training system. The projects that the students had to carry out is recommended by industrial partners and finally could give solutions to "real-workplace" problems. This acts as stimuli for learning or what we call 'learn by doing' and also giving them experiential learning. In addition, the process in solving the problems in their project, it helps the students to integrate and organize learned information in ways that will improve recollection and application of knowledge to future problems. Considering the problem-solving nature of the engineering profession and the complex, ill-defined nature of many issues surrounding sustainability, PBL is one of the necessary tool to enhance the development and competencies of the future and current engineers.

In order to maximize POPBL's potential, the INSEP programme run by CEC UTHM has established few criterias to be embedded in the training process; responsibility for their self learning, exploration and inquiry project oriented and multidisciplinary, Teamworking in both group- and self-directed work, reflection on learning, Self and peer assessment, critical thinking and problem solving skills, value of project in the real workplace, generic skill and industrial training. Therefore, INSEP programme is an innovative training to skill formation of engineering and technical graduates where the activities is much more than students working through problems to come up with an excellent and successful project. The training goals of the INSEP was to prepare sustainable engineers with human, methodological, technical and lifelong learning skills. The question is not how can we improve the current continuing educational system, but how can we create a more effective and efficient continuing educational system.

The INSEP program has dedicated itself to "reorienting continuing engineering education" in order to produce engineers that not only "appreciate and understand the human condition" but also "proactive"

and “competent problem solvers”. They are accomplishing their goals by using PBL, concept maps, and reflective narratives throughout their curriculum. These methods facilitate deep level understanding and help students visualize the “big picture.” The program also empowers its students and encourages them to take charge of their own learning, by allowing them to direct learning experiences (e.g. homework, assessment) that best meet their needs. In addition, CEC UTHM is putting engineering in a social context to produce a more diverse group of globally oriented engineers. CEC UTHM uses its strength in the multi discipline experts from the FPT, FTMM, FPTek and all the engineering faculties to incorporate social relevance, sustainability, open-mindedness, and creativity into its engineering program. This provides the INSEP students with an awareness and competencies needed by industries and that current graduates generally lack.

The ability of CEC UTHM INSEP Program to more fully integrate sustainability elements and social issues into the curriculum most likely stems from two important factors: (1) it was able to start from a ‘fresh innovative idea’ when it was established in 2005, and (2) the timing of the programs conception coincided with the implementation of National Dual System Training (NDTS) in Malaysia and a proliferation of knowledge on POPBL, as well as an increasing global awareness of sustainability issues. CEC did not have to overcome the barrier of reorienting a current system. CEC had the freedom to redress the weaknesses entrenched within traditional continuing education curricula. INSEP has successfully enhanced graduates with the skills most lacking in them, ie. critical thinking skills and the ability to collect, evaluate, and utilize information, dealing with uncertainty and ambiguity in problem solving.

Problem Statement

Current engineering graduates are entering the market place ill-equipped to deal with the problems of society and industries are facing (Noraini 2007). Thus, the modern engineers need to be equipped with the knowledge and skills to manage uncertainty and make judgments about the best course of action based on the available evidence which requires them to have strong problem-solving skills and to be able to evaluate the implications of their solutions beyond their immediate technical context ((Huntzinger, Hutchins, Gierke and Sutherland, 2005). Change and innovations is required in universities to deliver sustainable programmes. However, a framework to guide for sustainable programme development has not been developed in most CE especially in Malaysia. As a primary concern, the vital importance of the environment should be integrated across all disciplines and perhaps even be the core of all education. CE centers also need to constantly monitor their performance as well as that of industry and make their findings accessible to the public. Hence, the aim is to lay the framework of a sustainable development in CE centers through links to the real world.

This paper offers a new paradigm for continuing engineering education and proposes a framework for CEE where sustainability is embedded in the curriculum. It will explore in the aspects of its outcomes,

operational processes and structures, and its evolutionary processes which comprises of quality assurance, instructional methods, Learning Outcome, Curriculum design, staff, facilities, assesment and programme needs. Further, this paper proceeds on the assumption that the core elements of the engineers' role in modern society are project management, problem solving and solution development.

Research Objectives

The objectives of this research were:

- (i) to determine the current status of sustainable development oriented in CE centers
- (ii) to develop the framework of CEE program for sustainable development

Conceptual Framework

The conceptual framework, as shown in Figure 1, has been developed based on the major concern of CE centers to retrain or upgrade the people who are at works.

The main idea of developing the appropriate framework came from the non existence of guideline in the local CE centers about characteristics of the sustainable development oriented organization. After the analysis of program structures regard to sustainable development, then eight main components of the desirable framework were determined from: quality assurance, instructional method, learning outcome, curriculum design, staff, facilities and support, assessment, and program needs (Malaysian Quality Assurance Division, 2005; National Accreditation Council, MoHE, 2005; Engineering Accreditation Commission-EAC, 2007; Hong Kong Council for Academic Accreditation-HKCAA, 2007; International Association for Continuing Education and Training-IACET, 2005; and Continuing Education Centre, UTHM, 2007). The main components consisted of dimensions of environmental, economic, social, and cultural (Ahmed, Hadj, Joseph and Mohamed Elzain.; Posch and Steiner, 2006; and Sammalisto and Lindhqvist, 2008).

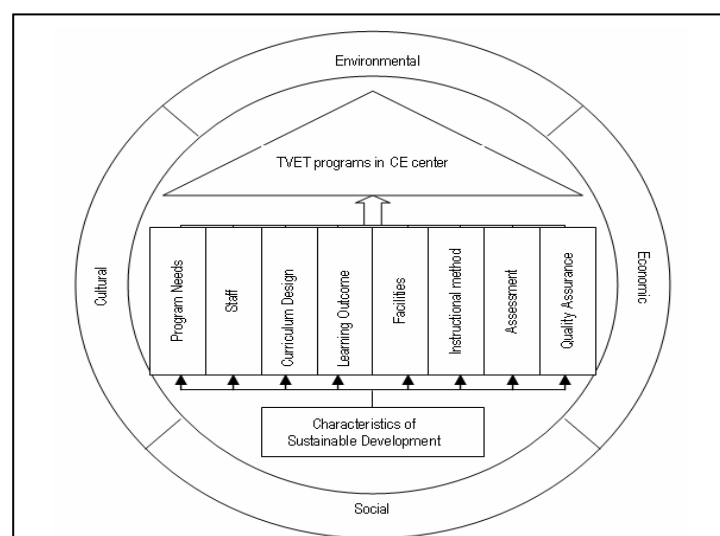


Figure 1: Conceptual Framework

Research Design and Methodology

The quantitative descriptive research design used in the present study involved questionnaires, interviews and document analysis. It was necessary to engage in both qualitative and quantitative data in this study to obtain the desired findings. The preliminary 'main components of program structure' of sustainable technical/engineering programme is discussed at several meetings and interview with stakeholders of CE and validated by several experts of TVET. Further and extensive literature search provide with preliminary criteria of each component which were then again validated by experts.

The Sample and Sampling of the Study

The selection of the institutions was made on the basis of their being representative of the technical oriented institutions in Malaysia. The institutions were also being selected because of their involvement and key stakeholders in continuing technical programmes.

The respondents in the study which were selected through purposive sampling, were staff and / lecturers/ directors or managers of CE at each of the selected higher education institutions in Malaysia. The researcher believe that this purposive sampling technique is useful for selecting a sample in relation to some criteria which are considered important for this study , i.e. the use of the best available knowledge of the sample with regard to TVET teacher training and programme accreditation (research in curriculum development, 1991). The sampling for the purpose of developing the subject recognition system concept was appropriate considering that the respondents are deeply involved either as teachers/ lecturers or managers. A total of thirty three (33) respondents were selected in this study.

Modified Delphi Study

A Modified Delphi Technique was used to answer the research questions. A key step in using the Delphi Technique is the identification and selection of the panel, since it is the panel's opinions and judgments that determine the outcomes of the study. Individuals who are recognized as experts in the area being studied should be selected for panel membership in Delphi research (Helmer, 1983; Dobbins, 1999). Identifying individuals considered experts in the Sustainable Continuing Engineering/Technical Education (CEE) comprised the first step in the selection process. In dealing with experts, there are basically three rules that should be followed: select your experts wisely; create the proper conditions under which they can perform most ably; and if you have several experts on a particular issue available, use considerable caution in deriving from their various opinions a single combined position. In an effort to increase the validity of this study, experts from a cross-section of the continuing education practitioner who are actively involved in managing and defining the needs for effective continuing technical education development in Malaysia, were utilized. A basic criterion for selecting experts was that they should be extremely knowledgeable in the area they represent.

Three instruments were used in this study (Refer Table 2, Appendix 2). In Phase 1 of the Modified Delphi Study, the first instrument identified as Delphi Probe will be open-ended. The other two instruments are identified as Delphi Round I (Phase 2) and Round II (Phase 3). In this study, the Delphi Probe will be developed as an open-ended questionnaire to promote thoughtful and creative responses from the panel. After this step, based on the responses by the experts, appropriate changes will be made in the statements based on suggestions of the review panel.

In Phase 1, research instruments were developed from the analysis results of those related literatures and also inputs from experts through the Delphi probe. The experts were then asked to check the validity and reliability of the questionnaires which consist of eight components and 43 items. This resulted in the initial instrument for Round I of the study. Further to that, Panel members' responses to Round I will be used to construct the Round II instrument. To assist in the development of sound conclusions and recommendations for the study, a criterion for consensus will be pre-established for the data.

In the second round, the researcher delivered or e-mailed the panel of experts, materials that consisted of a cover letter thanking them for their support and continued participation, and the Round II instrument.

The Round II instrument consisted of the statements for which there is not consensus among the panel members in Round I. In order that comparisons could be made between the respondents' personal ratings and the mean ratings of the panel, the rating scale included the individual's prior ratings. Panel members will be asked to reconsider their previous answers and revised them if they desired. Respondents will also be asked to state the reasons for any changes in their ratings. Panel members will be asked to return the instrument within a certain time (eg one week). The researcher will make personal or phone contacts with participants to clarify unclear or incomplete comments made on the questionnaires that might prove useful in data analysis. Since most Delphi studies have analyzed data by using a combination of means, median scores, and standard deviations (Dalkey, 1969; Uhl, 1983), for this study, the mean scores and standard deviations will be used to analyze the findings.

This 'Modified Delphi Study' was divided into three phases as follows:

Phase I: Identification of main components of program structures through literature review, benchmarking and experts advice

Components of program structures in six institutions such as Quality Assurance Division, Public Higher Institutions; National Accreditation Council, Ministry of Higher Learning, Malaysia; Engineering Accreditation Commission-EAC; Hong Kong Council for Academic Accreditation-HKCAA; International Association for Continuing Education and Training-IACET were purposively reviewed regarding to their experiences in CE or TVET. Then, research instruments were developed from the analysis results of those related literatures. The experts were asked to check the validity and reliability of the questionnaires form conducted in eight components and 43 items.

Phase 2: Development of the preliminary framework

The sample consists of 33 experts consisted of high ranking administrators of the CE centers and academic experts in TVET and sustainable development fields were purposively selected to verify and discuss the main components program structures regard to sustainable development including their comments and suggestions. Besides, the experts were asked to rate the current status of sustainable development practices in their centers. Data in this phase was collected by Delphi technique. Qualitative data were analyzed using content analysis, and SPSS was used to analyze quantitative data. Descriptive statistic, mean and standard deviation were used in finding consensus among the experts.

Phase 3: Evaluation of the appropriateness and the validity of the preliminary developed framework

The sample was 25 experts from those who involved in the second phase. The sample was asked to evaluate the appropriateness, viability and validity of the preliminary developed framework, using the same questionnaire in the second phase.

Findings and Discussion

The data gathered were analysed and shown as in Table 1 and 2 (Appendix 1). The analysis show that the current status of sustainable development practices in almost HEIs are at moderate level. Although there are programs that have successfully implemented skills into their curriculum, there are many factors that serve to hinder the philosophy of sustainability whereby less exposure and awareness towards sustainable development. This happens due to the non existence of guideline in the local CE centers. Perhaps this framework could help in the awareness and motivates for sustainable programme development. The Community colleges perceived that they are relatively sustainable as compared to polytechnics and universities (refer Table 1)

The analysis of the questionnaires and interviews of experts involved in Malaysian CE, converges into the following seven eight main components of program structures as follows:

- (i) **Quality assurance** – the analysis indicate that the quality assurance contributes significantly towards reorienting undergraduate education towards sustainable development. The Panels, in line with Wijeyaratne (2006), claimed that the quality in continuing education has been identified as a multi-dimensional concept which embraces teaching, academic programs, research, scholarships, staff, students, services provided to the community and the academic environment as a whole.
- (ii) **Instructional method** - the panel claimed that the desirable instructional method include a combination of classroom lecturing, problem-based learning, field-based learning or experiences, some sort of integrated project, and interdisciplinary understandings of

sustainability and environmental issues. Consequently, according to Farrel and Ollervides (2005), there is a need for people trained to work in an international setting, with a sound understanding of sustainability issues and the mechanisms for tackling them; or in a local setting with an international perspective. But, at CE level, sustainability education is often embedded within single-discipline subjects, rather than being taught per se as a separate subject (Leal Filho, 2002 in Buchan, Spellerberg and Blum, 2007).

- (iii) **Learning outcome** - panels claimed that at the end of the lesson, students will be able to bring all the learning in the program into application in their work practice. Therefore, it must be noted that this research focuses on providing of a necessary framework to guide the transformation from unsustainable development to sustainable development of CE program.
- (iv) **Curriculum design** – the panels, claimed that employability skills is very important to be included in CE curriculum and this is in line with Buchan, G.D *et al.* (2007). While emphasizing the need for the students to master the subject matter, there is also the need to exposed or immerse the students in the reality of the work fields.
- (v) **Staff** - the findings obtained show that education plays an important role in affecting how sustainable development can be achieved. Panels claimed that the effective way is promoting life long learning to the staff.
- (vi) **Assessment** – the panels, (as agreed by Buchan, G.D *et al.* (2007), claimed that the students became too preoccupied with assessment, and they were not given the incentive to read widely around the subject. Therefore, they preferred assessment is conducted in continuous rather than examination-oriented.
- (vi) **Facilities** - in addressing the challenges to productive use of energy, panels claimed that is important to CE programs to be conducted in appropriate rooms depend to the capacity of students.
- (viii) **Program needs** - as education can increase agricultural productivity, empower women and change their status, decrease population growth rates, promote environmental protection, and positively influence the standard of living (McKeown, 2002), panels claimed that is important to ensure CE program is to reorienting education for better lifestyle.

The analysis of the data showed that the criteria of the eight components are of important (Refer to Table 2, Appendix 1).

The framework developed is shown in Table 3.

Table 3: A Framework of Sustainable Development in CE

TITLE	A Framework of Sustainable Development in Continuing Education Centers
OBJECTIVE	This framework is developed as guideline for executing CE programs regard to sustainable development at CE centers in HEI
Components of CE program according to sustainable development priority	Characteristics of CE programs regard to sustainable development dimension such as environmental, economic, social and cultural
Quality Assurance	<ul style="list-style-type: none"> • Continuing education and training is provided to staff. • CE program syllabus is revised for certain due and compatible in current market. • CE program is audited by authorized unit. • CE center has the sustainable development policy. • CE program is observed based on sustainable development specification.
Instructional Method	<ul style="list-style-type: none"> • Generate employability skills. • Integrate the human values. • Practice health and safety procedures. • Practice the ethical procedures in R&D. • Practice the waste management procedures. • Practice the student-centered method. • Practice the problem-based learning method.
Learning Outcome	<ul style="list-style-type: none"> • Student will obtain employability skills. • Student will be more concern on future needs. • Student will practice critical thinking. • Student will recognize the culture of every ethnic. • Student will practice healthy lifestyle.
Curriculum Design	<ul style="list-style-type: none"> • CE curriculum consists of employability skills. • CE curriculum infused certain topic regarding sustainable development within various subjects. • CE curriculum offers a specific subject regarding sustainable development. • CE curriculum is research-based. • CE curriculum includes the community services.
Staff	<ul style="list-style-type: none"> • CE staff practices the life long learning. • CE staff has education background in sustainable development fields. • CE staff is motivated to do research on global problems. • CE staff practices paperless campaign. • CE staff put an effort to promote the social campaigns.
Assessment	<ul style="list-style-type: none"> • Assessment is conducted in continuous. • Assessment is based on employability skills. • Assessment is based on ethical aspects. • Assessment is based on social skills. • Assessment is based on multi approach; includes projects and examination oriented.
Facilities	<ul style="list-style-type: none"> • CE programs are conducted in appropriate rooms depend to the capacity of students. • Instructional resources are assessable to student.

	<ul style="list-style-type: none"> • Consultancy services are provided without prejudice. • Facilities used in CE center are established environmental friendly products. • Offer international level research opportunities.
Program Needs	<ul style="list-style-type: none"> • Aim of CE program is to reorienting education for better lifestyle. • Aim of CE program is to provide life long learning. • Objective of CE program is to enhance knowledge on sustainable development. • Objective of CE program is to enhance the public awareness regarding future needs. • CE program is offered to disability person.

Conclusion

Current status of CE programs regarding sustainable development have been recognized as a global priority although several barriers have been noted, including the difficulty implementing sustainability at the universities, polytechnics and community colleges level. However, these programs may represent a good alternative or otherwise help to supplement sustainable development education within higher education. More importantly, the flexibility of CE programs might facilitate the integration of environmental, economic, social and cultural issues; all of which are important dimensions of sustainable development. The research affirmed that the time has come for the other CE centers to adapt and implement sustainable development value and practices.

Successful integration of sustainability into engineering curricula requires a change in the approach to education. Learner-centered environments are a prerequisite to the redesign of continuing engineering education for sustainability. Because moving towards sustainability requires open-mindedness and collaboration with a broad range of stakeholders, including industry, government, students, and educators, a top-down approach to reform may not work. Therefore, incorporating sustainability into higher education requires a new "vision of possibilities" and an evolution in our way of thinking.

Recommendations to policy-makers and stakeholders of HEI, the voice from the academic experts must be heard concerning this very crucial issue includes creating an institutional framework or similar mechanism to develop a system or approach for community integration and involvement, and direct management activities towards sustainable development goals.

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Table 1: The current status of sustainable development oriented in CE centers

Components of Program Structures	Current Status of Sustainable Development Practice in CE Centers by Institution			Overall Status in HEI
	University	Politechnic	Community College	
Program Needs	3.3053 (Moderate)	3.6286 (Moderate)	3.8286 (Good)	3.4848 (Moderate)
Learning Outcome	3.4842 (Moderate)	3.6000 (Moderate)	3.6571 (Moderate)	3.5455 (Moderate)
Curriculum Design	3.4316 (Moderate)	3.2286 (Moderate)	3.4286 (Moderate)	3.3879 (Moderate)
Instructional Method	3.6992 (Moderate)	3.7551 (Moderate)	3.6327 (Moderate)	3.6970 (Moderate)
Assessment	3.4211 (Moderate)	3.5714 (Moderate)	3.3571 (Moderate)	3.4394 (Moderate)
Staff	3.4211 (Moderate)	3.6571 (Moderate)	3.6857 (Moderate)	3.5273 (Moderate)
Facilities	3.2947 (Moderate)	3.1429 (Moderate)	3.4000 (Moderate)	3.2848 (Moderate)
Quality Assurance	3.1053 (Moderate)	3.3143 (Moderate)	3.3714 (Moderate)	3.2061 (Moderate)
Total	3.3953 (Moderate)	3.4872 (Moderate)	3.5452 (Moderate)	3.4466 (Moderate)

Table 2: The main components of program structures regard to sustainable development

Main Components of Program Structures regard to Sustainable Development	Mean Score	Standard Deviation	Interpretation
Quality Assurance	4.3212	.55888	Important
Instructional Method	4.2987	.55600	Important
Learning Outcome	4.2970	.57015	Important
Curriculum Design	4.2606	.54883	Important
Staff	4.2242	.64761	Important
Facilities	4.2000	.63836	Important
Assessment	4.1465	.59330	Important
Program Needs	4.1152	.57015	Important

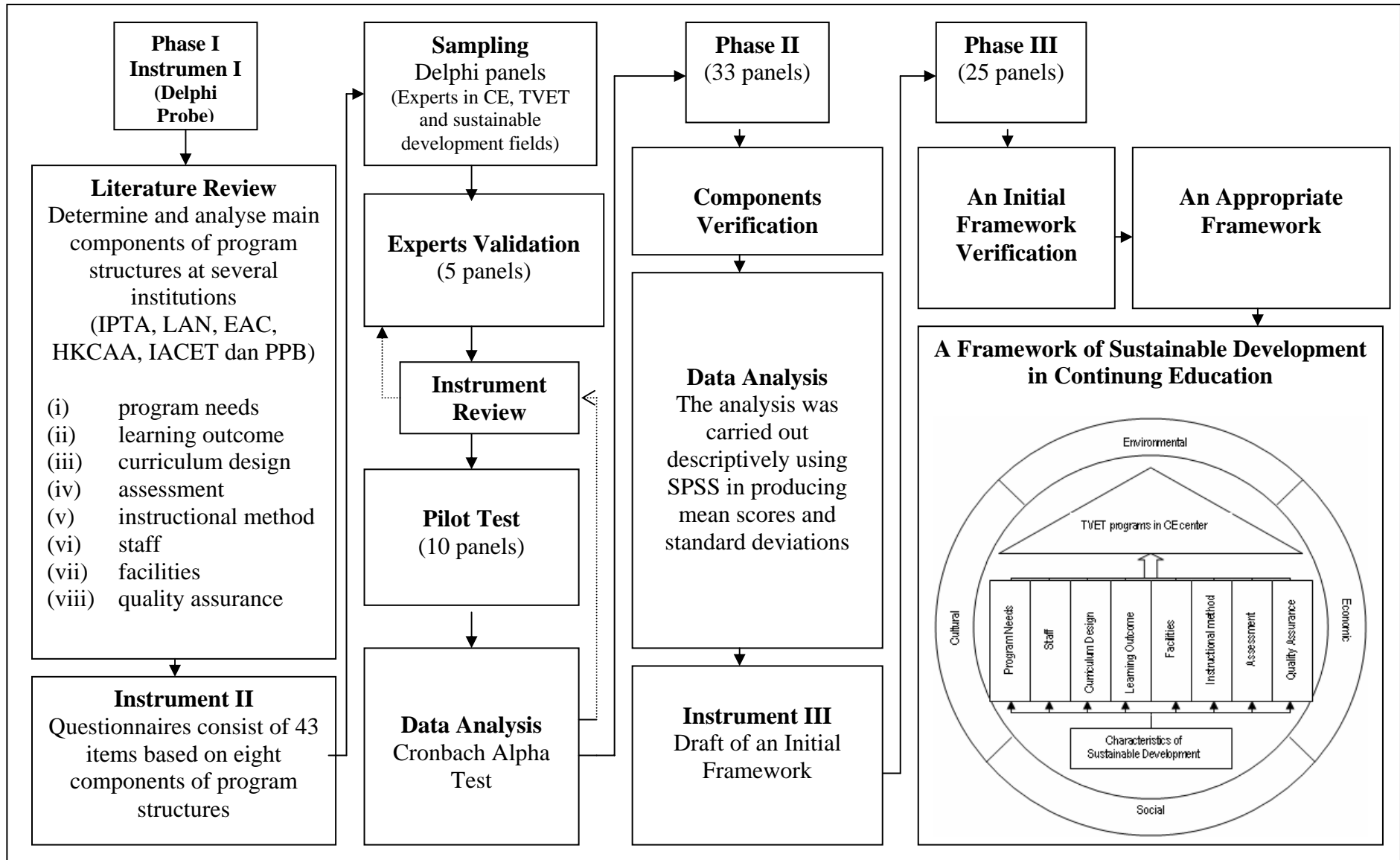


Figure 2: Research Design (Adapted from Wiersma and Jurs, 2000; and Seehanath, Kanjanawasee and Pitiyanuwat, 2006)

